AD-A163 569 DAMPING CHARACTERISTICS OF METAL MATRIX COMPOSITES(U) 1/1
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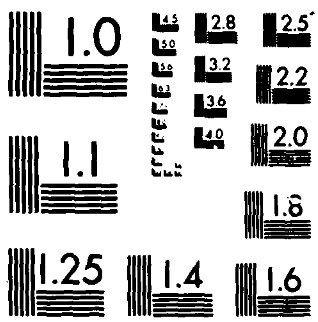
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QUARTERLY LETTER REPORT

Damping Characteristics of Metal
Matrix Composites

N00014-85-C-0857

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I. Contract Information

1.a. Title: Damping Characteristics of Metal Matrix Composites

1.b. ONR Contract Number: N00014-85-C-0857

1.c. Principal Investigator: Mohan S. Misra, Martin Marietta Aerospace, Denver, CO

1.d. ONR Scientific Officer: Dr. Steven G. Fishman

1.e. Period Covered: 9/15/85 to 12/11/85

II. Research Description

II.a Introduction

Fiber reinforced metal matrix composites (MMC) are candidate structural materials for Large Space Structures because of their high specific stiffness, specific strength, and low coefficient of thermal expansion. In addition, MMC exhibits higher damping than structural alloys of aluminum or titanium, and the potential exists for designing MMC with predetermined damping, strength, and stiffness properties.

In the present investigation P55/6061 Al composites with different fiber-fiber (consequently, fiber volume) spacing have been selected to study the damping characteristics.

II.b Objectives

(i) To identify the mechanism and the source of damping in MMC (P55/6061 Al).

(ii) To determine the role of microstructural parameters, e.g., volume fraction and fiber-fiber spacing in the damping behavior of composites.

(iii) To define the role of fiber-matrix interfaces in the damping capacity of MMC.

II.c Technical Approach

A systematic approach to study the role of microstructural parameters and fiber-matrix interfaces, P55/6061 Al composites have been designed with varying fiber-fiber spacing (λ_f), as shown in Figure 1.

P55/6061 Al panel #1, with λ_f = 3mm and face sheet only on one side of the panel will be used for in-situ damping measurements

P55/6061 Al panels #2, #3, #4 have λ_f = 6mm, 3mm and 0.5mm, respectively

6061 Al/6061 Al panel #5, with λ_f = 0.5mm will be used for comparison with panel #4, to determine the contribution of graphite fibers in the damping capacity of P55/6061 Al composites.

II.d Tests in Progress

II.d.1 Analytical Modeling

Composite materials attain their properties through interactions between fiber and the matrix materials. Consequently, the nature of bonding between the precursor wires and metallic face sheets in MMC significantly effects the strength, stiffness and damping properties.

Our major subcontractor, Material Science Corporation, has initiated the finite element analyses to determine the effect of implanted defects (at interfaces) under generalized loading states. This analytical modeling, along with the test data, will provide the understanding of operative damping mechanisms in MMC.

II.d.2 In-situ Damping Tests

Moire Interferometry - Preliminary damping tests are in progress at Idaho National Engineering Laboratory, to detect any movement at fiber-matrix interfaces by using 2400 l/mm grating on the free edge of longitudinal and transverse specimens of P55/6061 Al; in tension-tension loading conditions.

Acoustic Emission (AE) - AE tests are being performed to obtain the characteristic AE signature and in-situ damping behavior of P55/6061 Al precursor wires and composite specimens in the extensional mode. To minimize extraneous noise-interference, a special Hysol adhesive, EA 9330.4, having low filler content ($<$ 5%)

and no asbestos, has been used in the preparation of end tabs. The special alignment jig designed for precursor wires and the test set up are shown in Figure 2, 3, and 4.

Vibrothermography or Infrared Microthermography - During flexural vibrations, thermal gradients are generated between the plies due to thermoelastic effects. Preliminary tests to detect such thermal gradients between fibers and matrix, are in progress by using vibrothermography (SPATE 8000 stress analyzer) and by Infrared microthermography using computherm thermal analyzer.

II.e Damping Tests

P55/6061 Al specimens have been prepared to conduct damping capacity measurements by the free-free flexural method in vacuum and also by the tension-tension loading method.

II.f Presentation

None

II.g Technical Reports

None

II.h Publications

None

II.i Participants

Analytical Modeling: Material Science Corporation, Spring House, PA
Damping Tests: University of Texas A&M
Acoustic Emission Study: University of Denver, CO

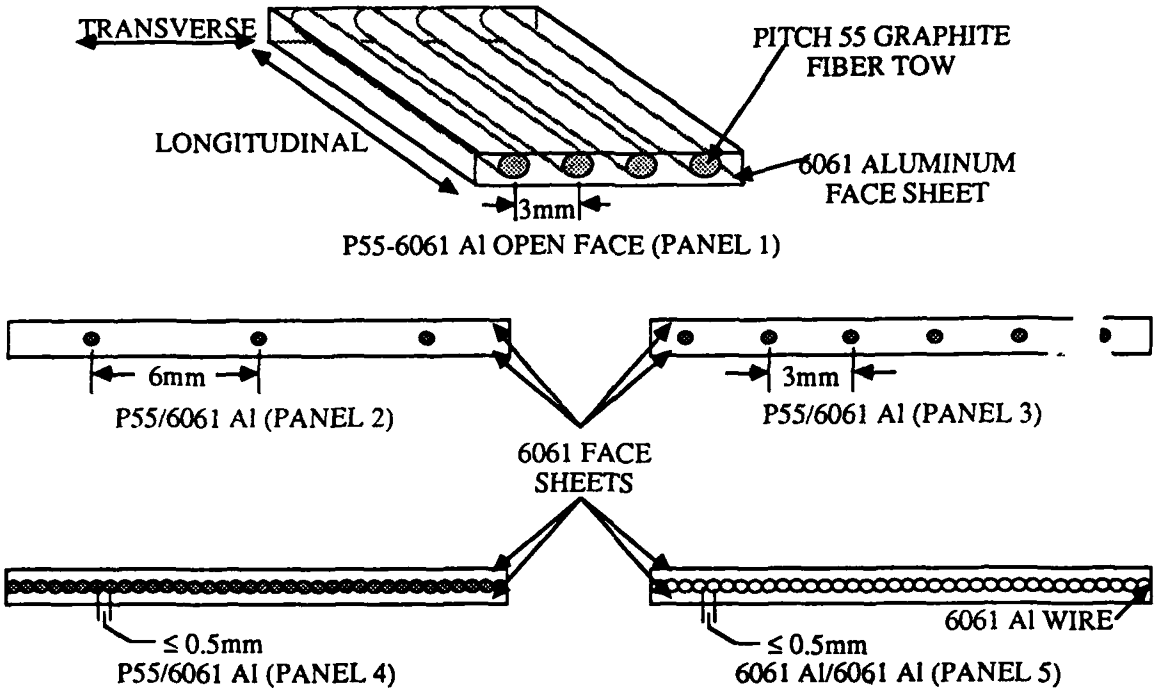

Figure 1 P55/6061 Al for Composite Panel Design with Varying Fiber-Fiber Spacing

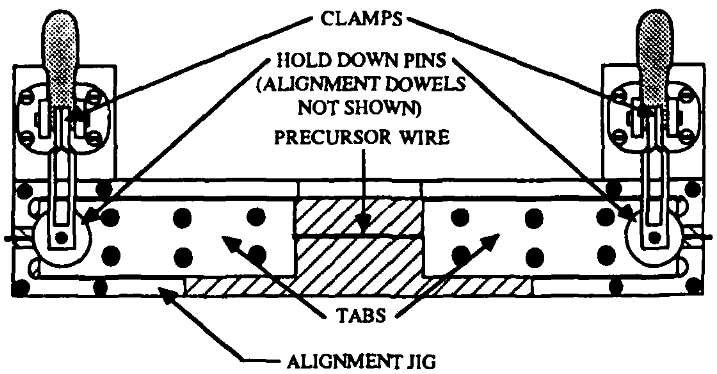

Figure 2 Alignment Jig for Precursor Wire Specimens During Adhesive Curing

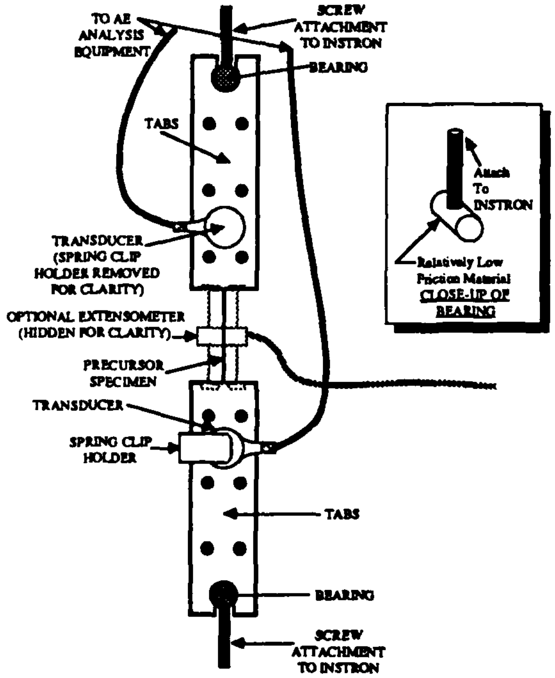

Figure 3 Acoustic-Emission, Test Set-Up for precursor wire specimens

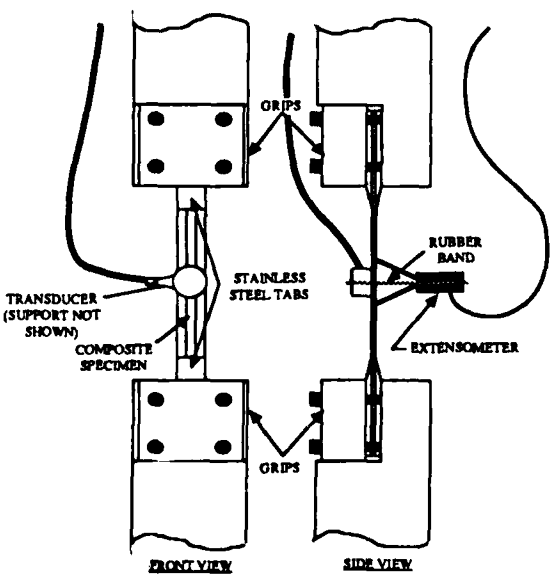

Figure 4 Experimental Set-Up for Acoustic Emission Analysis of Composite Specimens

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